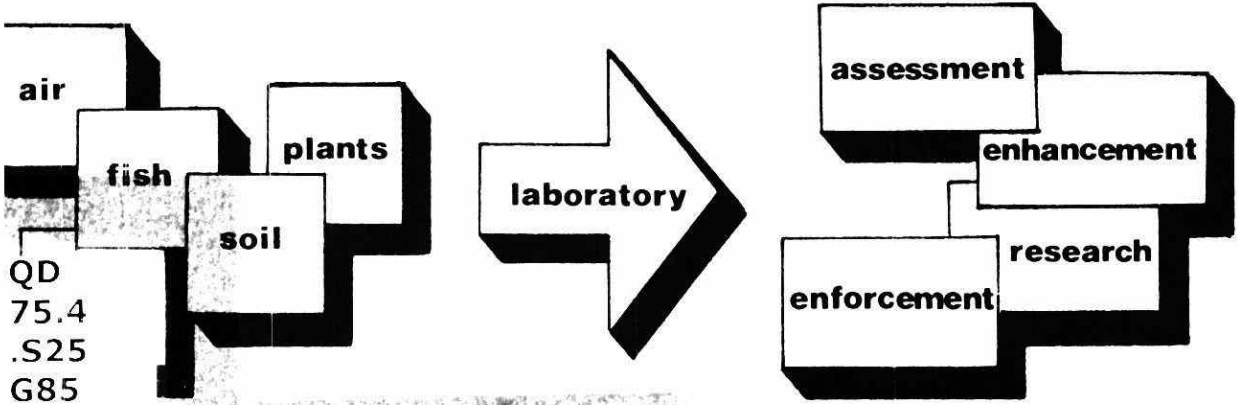
A GUIDE TO THE COLLECTION AND SUBMISSION OF SAMPLES FOR LABORATORY ANALYSIS



Laboratory Services Branch

A GUIDE TO THE COLLECTION AND SUBMISSION

OF

SAMPLES FOR LABORATORY ANALYSIS

FOURTH EDITION

Co-ordinated by
Water Quality Section
Laboratory Services Branch

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A GUIDE TO THE COLLECTION AND SUBMISSION OF SAMPLES FOR LABORATORY ANALYSIS

INTRODUCTION

Sample collection is the first and commonly most critical stage in the step by step procedure used to determine a substance or group of substances in the environment. From the standpoint of data interpretation, it is normally assumed that a representative sample has been taken. If the sample is not, in fact, representative, then this should be noted to avoid erroneous data interpretation. Similarly, once the sample has been collected, improper use of preservation techniques to stabilize the sample and delay in transportation may lead to questionable results.

In general, the sampler's aim must be to collect a representative sample from a known position (location) and transfer it to the laboratory with a minimal change in chemical composition of the parameter of interest. It is of little value to make an accurate analysis of an incorrectly collected sample.

IT CANNOT BE EMPHASIZED TOO STRONGLY THAT THE SAMPLER
PLAYS A KEY ROLE IN ENSURING THAT THE DATA OBTAINED
REFLECTS THE FIELD SITUATION BEING ASSESSED.

ONTARIO MINISTRY OF THE ENVIRONMENT - LABORATORY SERVICES BRANCH

The various laboratories of the Laboratory Services Branch are equipped to perform a large number of chemical and microbiological analyses on domestic water supplies, surface waters, ground waters and domestic and industrial wastes. Fish, vegetation, soil samples, hi-vol filters, precipitation and snow samples are also analyzed by these laboratories. Special analyses required for research studies and unusual pollution problems can also be provided.

Decentralization of the Ontario Ministry of the Environment has resulted in the designation of six regions with boundaries as given in Figure 1. Three of these, the Northwestern, Southwestern, and Southeastern, have regional laboratories located at Thunder Bay, London and Kingston respectively. Samples collected within these regions are analyzed at the appropriate regional laboratory when analytical capability is available. When such capability is not available, these samples plus all those from the other three regions are analyzed at the Toronto Laboratory. The chemical tests performed by each regional laboratory as well as the six sectional laboratories in Toronto, are outlined in Table I. Field samplers should ensure that a laboratory is capable of analyzing the parameter(s) in question before shipping. Mobile laboratories and field stations are often provided to perform a limited number of tests in conjunction with major surveys or studies.

The Toronto Laboratory, located on Resources Road, consists of the following sections: Water Quality, Air Quality, Organic Trace Contaminants, Pesticides, Physical Methods and Microbiology.

A. SAMPLE COLLECTION FOR WATER QUALITY ASSESSMENT

A - I. SAMPLE COLLECTION FOR CHEMICAL ANALYSIS

1. GENERAL CONSIDERATIONS

The method of sample collection in the field is the responsibility of the individual involved. The following points should be noted:

a) The sample must be truly representative of the whole.

b) All possible sources of sample contamination (sampling devices, motor exhausts, disturbing of bottom sediments, use of inappropriate containers, etc) should be eliminated or reduced to a minimal level.

c) Since sample composition will change with time, rapid transportation to the laboratory is desirable. For some parameters, use of a preservative is recommended. Theoretically, this should fix the concentration of the parameter of interest and reduce the need for rapid transport and analysis (See Section A-I Part 3). However, in practice this only delays the perishability of the parameter and the sample should still be transported as quickly as possible.

d) For samples which do not have a preservative already in the collection bottle, rinsing both the bottle and cap with sample (two or three times) is strongly recommended. This procedure, while reducing any contamination that may be present, also tends to equilibrate the sample with the container walls and hence "container effects" (leaching, adsorption, etc) are minimized.

2. SAMPLE CONTAINERS

In general, surface water samples are collected in 1 liter glass bottles, but some analyses require special plastic containers or glass tubes. Table II summarizes the proper sample container for each parameter. Note for instance that low level nutrients must be submitted in polystyrene containers only. Special studies may require a certain container type or sample pretreatment during sample collection. It is the responsibility of the sampler to obtain the proper sample container for special studies on special analytical requests.

Precipitation sampling should be conducted using sample collectors designed to catch precipitation as it falls. Once the sample has been collected it is transferred to plastic polystyrene or glass bottles. Special acid washed plastic containers are required for trace level metal analysis.

Sludge samples are collected in wide mouth glass or plastic bottles and never filled more than half way. The extra space is required as an expansion zone for gaseous products that may be formed. Failure to submit samples in this manner may result in container explosion during transit or at the laboratory. Overfilled sludge samples are discarded without analysis. Sludge samples for trace organic contaminant analysis other than TOC, BOD, COD and volatile acids must have a foil lined cap.

For trace level metal analysis on surface and domestic waters, special acid washed plastic containers are required. Standard glass containers with nonmetal cap liners should be utilized for all other routine water samples requiring metal determinations.

Analysis for filtered total phosphorus requires a field filtered sample collected in a special prewashed, precalibrated culture tube that is provided by the laboratory (Rivers and Lakes Laboratory, Water Quality Section, 248-3512).

Note that samples submitted for physical testing such as particle identification (see Section D-II) or microbiological analysis are generally unsuitable for chemical analysis and vice versa. An appropriate separate bottle should be submitted for each of these test types when more than one is required.

Aqueous samples for the analysis of organic contaminants should be submitted in 1 liter glass bottles with foil lined caps. The sample should have no head space and should be refrigerated. Care should be taken to avoid freezing the sample. If analysis of hydrocarbon gases is required, approximately 20% head space should be provided.

PCB and pesticide samples must be collected in new 1 liter glass bottles that have been previously rinsed with methylene chloride followed by acetone. These specialized containers are prepared and marked at the laboratory. Do not fill these special containers above the indicated level.

3. PRESERVATION TECHNIQUES

The function of a preservative is to stabilize the parameter of interest so that changes in composition during transit and the time prior to analysis are minimized. Several different preservation methods are recommended and these are outlined by parameter in Table II.

Preservation techniques usually involve the addition of a chemical which "ties up" the parameter in a form which is unaffected by sample ageing or else provides conditions unsuitable for any further reaction to occur. In some cases, refrigeration or freezing to reduce reaction rates provides the best preservation, particularly for those parameters which have a direct biological relationship (i.e. with respect to growth or decline, for example, nutrients). Preservation for some parameters is effective, for others it serves only as a technique to marginally reduce the decay or conversion rate. Therefore, it is imparative for such parameters as phenol, chlorophyll etc, that every effort be made to submit the samples to the appropriate laboratory as quickly as possible to avoid or reduce loss.

The sampler should be aware that the use of the recommended preservative for one parameter may negate the possible analysis of another. For example, heavy metal samples preserved with nitric acid are unsuitable for phosphate analysis. It is the sampler's responsibility to determine whether use of a certain preservative will eliminate the possibility of analysis of another requested parameter, and provide suitable duplicate samples to avoid the problem. If in doubt, consultation with laboratory staff is advised. Each duplicate should have the preservative used clearly marked on the bottle label.

4. SAMPLE VOLUME

The analytical methods used to determine parameter concentrations require a certain minimum volume of sample in each case, as outlined in Table II. The field sampler is expected to calculate the total volume of sample required by summing the specified individual volumes (Table II) for all the analyses requested and to submit the appropriate quantity. In addition, samplers are asked to submit at least 180 mL of sample in excess of their original total estimate to allow for possible repeat analysis. Failure to provide sufficient sample volume will normally result in "Sample Exhausted" being marked on analysis report sheets.

In most cases, the volume required for analysis depends on parameter concentration, with "clean" samples (i.e. low concentrations) needing the largest amounts. Domestic water supplies, well waters, and unpolluted surface waters fall in this category. Tests for these sample types require the largest practical volume in order to provide a sufficient quantity of the substance of interest for reliable detection. Samples of high concentration (effluents, sewages, etc.) require a much smaller amount, and even a dilution may be employed.

In certain cases where the sampler is unable to obtain sufficient sample volume or when resampling is impossible, analysis may still be obtained if special care and analytical techniques are used in the laboratory. This can only be achieved after consultation with laboratory personnel has been initiated by the sampler and before sample submission.

5. SAMPLING METHODOLOGY

The sampler should be aware of how the particular details of his procedure (geographic location, time of day, method of obtaining the aliquot, etc.) may bias the results which are eventually obtained.

Care should always be taken to minimize sample cross-contamination by carefully rinsing (with sample) all sampling equipment used in collecting the aliquot which is sent to the laboratory. These precautions are particularly important for low concentration parameters.

6. FIELD RECORDS

It is in the sampler's own interest to keep complete records of his sample collection activity not only from the standpoint of date, sample number, location, description, etc, but also with regard to unusual features which may be extremely useful in interpreting the analytical data. This information may also prove invaluable in the event of sample loss, misnumbering of sample bottles or report sheets, etc.

A - II. SAMPLE COLLECTION FOR MICROBIOLOGICAL TESTING

1. GENERAL CONSIDERATIONS

It is the responsibility of the sampler to use aseptic techniques when handling the sterile bottles used for microbiological sample collection. Failure to do so will result in sample contamination and meaningless results. It is recommended that the techniques described below be closely followed in order to obtain reliable data.

2. MICROBIOLOGY PARAMETERS

Table I lists the microbiological parameters performed in each laboratory with specific parameter information given in Table II. If the pollution sources are complex and/or there is doubt as to the most appropriate selection of bacterial parameters, then the Microbiology staff should be contacted.

3. SAMPLE CONTAINERS

Presterilized 180 mL bottles usually provide adequate volume (150 mL) for routine analyses. Water from water treatment plants, distribution systems, sewage treatment plants and any water that has been chlorinated or in which a chlorine residual is suspected, should be sampled in presterilized 180 mL bottles containing sodium thiosulphate (red label).

Samples for sulphur cycle bacteria analyses should be collected in bottles without sodium thiosulphate (blue label) unless otherwise instructed by Microbiology personnel.

Samples collected at depth, are taken using sterile sampling bulbs which can be obtained from the Microbiology Section in Toronto.

4. PRESERVATION TECHNIQUES

Sodium thiosulphate is used to neutralize the disinfecting properties of chlorine thereby preserving the existing microbial population at the time of sampling. This preservative is already present in the red labelled sample bottles. Keep samples cool, preferably through refrigeration or ice, and away from light during transportation to the laboratory. Frozen samples will not be accepted.

5. SAMPLE VOLUME

In general, one bottle or bulb per sample provides sufficient volume for standard analyses. If, however, the bacteria levels expected are very low or extra parameters are being requested, then additional samples may be required. Consultation with Microbiology staff is advisable in such cases.

6. SAMPLING METHODS

Sterile sampling bottles are available through Central Stores in Toronto, and regional laboratories. For special studies, alternate bottles are obtainable through Microbiology staff on consultation. Samplers should check to see if the plastic seal on each container is intact before sampling. Containers with loose or cracked seals should not be used. All samples should be collected early in the week and shipped to the appropriate laboratory. During spring, summer and fall, samples should be packed in ice to minimize biological activity. In winter, samples should be packed in insulating material to prevent freezing while still keeping them cold. Immediate delivery to the laboratory is essential. Analysis within six hours is preferable, but should not exceed twenty-four hours.

Strict adherence to the following sampling procedures is recommended:

a) SURFACE SAMPLES

Clamp the bottle onto a sampling pole before removing the cap. Touch only the outer surface of the cap when opening the bottle. The inner lip and liner must not come in contact with anything except the atmosphere. If the inner surfaces of the cap or bottle lip are accidently touched, the sample has been contaminated and should not be submitted. The recommended procedure is to hold the cap with your fingertips until the sample has been taken. The cap must not be set down somewhere while the sample is being taken as this will result in contamination.

Surface sampling is accomplished by quickly lowering the sample bottle into the water approximately one meter below the surface with the mouth facing into the current. When sampling near shore, care should be taken to get a sample uncontaminated with sediment. The bottle is then removed from the water, the level adjusted to the top of the label, immediately capped, and then unclamped from the sampling pole. Samples must be collected using this prescribed technique. The use of a dipper or other sampling device will result in contamination.

b) DEPTH SAMPLES

Depth samples are taken using sterile sampling bulbs. Bulbs should be used as quickly as possible: if not used, they should be returned to Microbiology staff within a maximum of two weeks, otherwise, the rubber will crack and the bulb will not open. The same care that is used with sampling bottles must be used in the handling of bulbs. The glass plugs supplied have been sterilized within a cellophane envelope and must not come in contact with any contaminated surfaces when they are being removed from the cellophane envelope. If, for some reason, the sampler should run out of glass rods, he may dip the metal plug into alcohol and flame it. After flaming, the plug is immediately inserted into the bulb, taking the usual precautions when handling sterile equipment. The use of the metal plug is discouraged and it should only be used in rare instances when the sample could not possibly be obtained at a later time in the correct manner.

c) TAP SAMPLES

Samples from taps must be taken only after aerators, screens, hoses, etc, have been removed. Prior to sampling from a tap, the water should be allowed to run at full flow for approximately two minutes. The strong flow will clean out residual contamination around the orifice of the tap thus ensuring a more representative sample. The water pressure may then be reduced to permit taking the sample without excessive splashing which could result in contamination of the sample.

Fill the bottle to the top of the label being certain that the mouth of the bottle does not come in contact with the tap or any contaminated surface. The cap must also be handled aseptically as described previously.

d) SAMPLING DUPLICATION

When a duplicate sample is being taken, it should be obtained at the same time as the first sample. This can be achieved for surface samples by clamping two bottles on a sampling pole, and for depth samples by placing two bulb samples on the sampling line in a "piggy-back" fashion.

A - III. SAMPLING FOR ASBESTIFORM MINERAL FIBRE

Asbestos determination involves a time consuming electron microscopic inspection. The extreme care and time required for this analysis makes it a very costly test, and very long sample back-logs are common. For these reasons no sample should be submitted without previous consultation with Physical Methods personnel.

Water samples should be collected in a 1 liter plastic bottle. As a rule, only new bottles should be used. On request, precleaned bottles will be supplied by the laboratory. The usual precautions of multiple bottle rinsing, rapid transport to the laboratory etc, are of particular importance for the collection of asbestiform mineral fibre samples. Samples should be sent to the Physical Methods Section, MOE, Resources Road, accompanied with the sample submission form.

A - IV. PRECIPITATION SAMPLING: RAIN OR SNOW

1. EVENT SAMPLES

Event samples are collected in large clean plastic bags, which have been inserted in garbage cans for support, and exposed over a 24 hour period. The samples collected in the bags are transferred to polystyrene containers and the volumes measured. A portion of each sample is transferred to a 60 mL polyethylene container and preserved with 0.5 mL concentrated nitric acid. The polystyrene containers are used for routine chemical analysis while the polyethylene containers are used for metal analysis.

2. LONG TERM SAMPLES

Long term sampling is conducted over a period of several weeks to a month. Samples are collected using Sangamo or Earth Sciences samplers, which are automatically activated during precipitation events and are closed all other times.

A secondary type of sampler (homemade) which is continually open is used for bulk sample collection, i.e. precipitation and particulate matter. Normally it is the responsibility of the field sampler to determine the total volume collected and to transfer the precipitation samples to appropriate containers before submitting them to the laboratory for analysis. Snow samples are thawed at room temperature prior to quantitative transfer into plastic or glass bottles. Once in the bottles, the sample should be handled in the same manner as other water samples, i.e. with regard to storage, preservation, shipping, etc.

A - V. SNOW SAMPLING

1. GENERAL CONSIDERATIONS

A snow sampling survey should be designed to provide an adequate number of sample points to cover the area considered to lie within the zone of contamination. Two control samples, remote from any known source of contamination are recommended for each investigation. Sample sites should be in undisturbed locations, away from roads or other local sources of contamination, sufficiently open to permit the free fall of snow but not exposed to excessive drifting. To avoid contamination from dead vegetation or other matter near the ground, snow sampling should preferably be undertaken only when the total depth of snow exceeds 25 cm. The quantity of snow required for analysis will depend upon the types of parameters requested. Generally, sufficient snow to yield 2 liters of meltwater is adequate.

2. SAMPLE COLLECTION

Samples are collected by means of a plastic cylinder, i.e. a dustfall jar with bottom removed, or similar device free of metallic parts. The cylinder should be of sufficient size to accommodate the expected total depth of snow. Insert the cylinder into the snow to the required depth, clear the snow from around one side of the cylinder and raise the cylinder about 5 to 10 cm off the ground. Insert a hard, clean plastic plate under the base of the cylinder and remove cylinder and contents. Transfer the collected snow into clean heavy gauge polyethylene bags and retain in unmelted condition until ready for processing. Record the number of cores obtained at each site, total depth of snow, surface area sampled, the kind and amount of visible surface and subsurface contaminants. Duplicate samples are collected at each site to avoid data loss and to assist in interpreting any anomolous results.

3. SAMPLE PROCESSING

The sample material is transferred to a second clean polyethylene bag, placed in a plastic pail and allowed to melt in the bag (usually 12 - 18 hours). The meltwater is quantitatively transferred to a 4 liter beaker in which the volume (to nearest 100 mL) is measured. After vigorous mixing, to ensure uniform distribution of particulate matter, appropriate aliquots are

poured into sample containers, depending upon the type of analysis and preservation treatment required. For most analysis, 1 liter plastic bottles are suitable for sample submission.

A - VI. CHEMICAL AND PHYSICAL FIELD ANALYSIS

The perishability of some parameters for which no chemical preservative is suitable necessitates field measurement. In the case of major field studies, a field laboratory facility for this purpose may be warranted. For example, such parameters as dissolved oxygen, dissolved carbon dioxide, free chlorine, chloramines, hydrogen sulphide and temperature are extremely perishable so on-site analysis is recommended. Temperature and dissolved oxygen are conveniently measured using electrode sensors (and/or Winkler titration for dissolved oxygen) while dissolved carbon dioxide, free chlorine, and chloramines require more complicated analytical techniques. Prior consultation with the Laboratory Services Branch, Water Quality staff, is recommended in these cases.

A - VII. PARAMETER GROUPINGS

Although the laboratories have analytical capabilities for a wide diversity of water quality parameters, certain compatible groupings are requested with a consistently high frequency. Such group requests are usually associated with routine monitoring programs and/or specific projects. It is the nature of the groupings to allow analysis of all the specified parameters on a single or sometimes duplicate sample bottle.

Requests for any of these groupings should be made only when ALL the parameters are required. Specific environmental problems usually require specific analyses be performed and, therefore, use of these groups is of little value. Large projects and studies may find it advantageous to use a different grouping and these may be established after appropriate consultation with the proper laboratory personnel.

Attention is drawn to the "Outlines of Analytical Methods" available from the Water Quality Section, Resources Road, Toronto, for more specific information with respect to parameter descriptions, analytical methods, sampling restrictions.

A - VIII. SAMPLE SUBMISSION

1. SAMPLE BOTTLE LABELLING

Sample bottles must be clearly labelled and contain the following information:

a) A sample (sender's) number. The use of a simple field numbering system is encouraged.

b) Some other identification, normally the sample source or type (e.g. "Lake Temagami - Sharp Rock Inlet").

c) Presence of any chemical preservative added; all others will be kept refrigerated or frozen (i.e. as received) until time of analysis.

d) When appropriate, indication of a single specific analysis required for that one sample bottle; i.e. when the sample has been preserved for resins and fatty acids analysis, it should be labelled "For Resin Acids", or when submitted for preconcentration and heavy metal analysis, it should be labelled "For Preconcentration".

2. SUBMISSION FORMS

Submission forms must accompany all samples and should include the following information, completed in pen, preferably black.

a) The required analytical parameters listed in the designated space on the form. This listing should always be present including the occasions when a parameter group is specified. Samples cannot be accepted with such requests as "chemical analysis" or "all the metals". Specific parameter identification is necessary and in some cases (i.e. pesticides), the specific class or compound is required. If there is some doubt concerning which analysis to request, a brief description of the general problem or reason for sampling will enable the laboratory staff to select the appropriate tests.

b) The sender's number corresponding to the number marked on the bottle.

c) The same sample identification as to source or type as provided on the bottle label.

d) The sampler's name.

e) The name, address and phone number of the person to whom the results are to be reported.

f) The name and address of any other person(s) to whom additional copies are to be sent.

g) Sampling date.

h) Program or study under which the sample was collected. (Note region or head office branch).

3. GENERAL

If a group of related samples is submitted, a map of the area or the relative location of waste inputs is very helpful to the laboratory staff. Please number the samples in a logical order, e.g. downstream in a river. All analyses are routinely screened for anomalous results before they are released. Suspicious results might be improperly rejected whereas some details as to the location would confirm their validity. When a sample is sent to the laboratory, a description of known constituent(s) should be included on the submission sheet, particularly an unusual one such as an industrial waste contaminant. Interferences (reactions which produce false analytical results) can be eliminated by pretreatment if the analyst is forewarned.

Samples known to contain cyanide, arsenic, mercury or other toxic materials should be clearly marked (warning label with substance identification) for the protection of laboratory personnel.

When submitting samples for analysis of organic contaminants, be as specific as possible about the types of compounds to be determined, and also, when a specific source of contamination is suspected, send samples of the source material for comparison. In all cases, the use of glass bottles with foil or teflon lined caps is a necessity for organic samples. Sampling foams is particularly troublesome. This may be best achieved by sampling just the foam with a pomade jar, then breaking the emulsion, and repeating the process until sufficient volume is obtained (usually at least 10 times).

Identification of unknown contaminants is very time consuming. Samples should be as large as possible to allow a wide range of exploratory tests. The sampler should indicate whether qualitative or quantitative results are required. Any available information concerning the sampling point, possible contaminants, and industries implicated is extremely important for such samples. Organic compounds not readily identified by the other units in the OTC Section, may be submitted to the Mass Spectrometry unit for analysis.

Samples which are not homogeneous present analytical difficulties because it is virtually impossible to take a representative aliquot. If the sampler is only interested in one phase (aqueous, solid or immiscible organic), he should label the submission form accordingly. Otherwise the laboratory will consider the whole sample, and take aliquots of the mixture.

Samples sent to the Central Laboratory, Toronto, could be analyzed by as many as six different sectional laboratories; the distribution of analyses among these sections is shown in Table I. Sample processing is much more efficient if the sampler submits separate forms and separate sample containers if testing is to take place in more than one of these sectional laboratories. Your cooperation in this respect will be appreciated by everyone involved.

4. SAMPLE CONTAINER REQUISITION AND SHIPPING PROCEDURES

Sample containers may be requisitioned according to need using the information provided in Table IV.

Certain projects or studies may require the use of special container types, and appropriate enquiry should be made prior to requisition.

CN and CP Express provide the fastest and most reliable service for the shipment of environmental water samples in Ontario. Air express, parcel post, bus companies and other services discourage the shipment of water samples because of the damage caused to other shipments when breakage occurs.

Contract numbers are important as they provide the only means for tracing a lost shipment. Every shipment is assigned a contract number at the Express Depot, but it is generally up to the sampler to attach this contract number to each carton of his shipment. Identification stickers are provided by the Express companies upon request. Samplers are urged to keep a record of all their contract numbers.

Refer to Appendix II for the shipping addresses of the various laboratories.

A - IX. ENQUIRIES

People to whom enquiries must be addressed by telephone are listed in Appendix I.

All samples received by the Laboratory Branch are assigned numerical codes according to sample type. When the analyses are completed, the results are entered onto the original submission sheets, checked by senior staff, photocopied and sent for mailing. All original submission sheets are retained in the sample reception files. Laboratory staff are prepared to answer questions regarding the receipt and progress of samples but require the following information:

a) Municipality, Township, or body of water in which the sample source is located

b) Name of person etc to whom the analytical report is to be submitted

c) Name of program or study

d) Sampling date and estimated day of arrival at the laboratory

e) Location codes or other sample identification number. Laboratory numbers are preferred, if known

f) Type of sample (e.g. water, river, sewage, industrial wastes, Great Lakes, etc)

B. SAMPLE COLLECTION FOR AIR QUALITY ASSESSMENT

B - I. GENERAL CONSIDERATIONS

The reliability of final results are reflective of the care and format used to collect samples. The sampler should ensure that samples collected for air quality assessment are representative of the whole and that all possible sources of sample contamination are either eliminated or minimized. Since in some cases, specialized routine and non-routine techniques are involved in sample collection, the sampler is advised to consult laboratory personnel prior to initiating a survey. Information provided should include sampling locations, frequency, analytical requirements, etc. A written outline of the sampling survey should also be provided. Refer to the specific sampling technique writeup for information regarding the best way of transporting samples to the laboratory.

Testing capabilities are outlined in Table I, with specific parameter information given in Table II.

B - II. ROUTINE TECHNIQUES

1. CONTINUOUS AIR MONITORS

Sulphur dioxide, oxides of nitrogen, ozone, oxidant carbon monoxide, and reactive hydrocarbons are the pollutants that are regularly monitored as part of the air monitoring program in Ontario. Each region is responsible for maintaining and calibrating their own monitors.

Instruments have also been developed for other pollutants such as hydrogen sulphide, fluorides, vinyl chloride and mercury.

Sequential filtration samplers are also used to measure the soiling property of ambient air in co-efficient of haze units. The air sample is drawn through a paper filter tape on which the particulate matter is deposited. The period of sampling is variable generally being one or two hours. The deposit may be removed for elemental analysis.

Continuous air monitors are the best means of sampling and analyzing gaseous pollutants because the effects of handling and perishability are minimized by direct introduction of the sample into the instrument. This technique is expensive, requiring a heated shelter equipped with power and trained technicians to calibrate and maintain instruments on a regular and frequent basis.

2. DUSTFALL SAMPLING

A clean sealed polyethylene dustfall collector jar (30 cm tall x 15 cm diameter), identified by station number, is attached to a suitable supporting bracket, uncovered, and allowed to collect settleable particulate material over a one month period. Collectors are located to provide dustfall samples that are representative of the area being studied.

Each collector should have a clear field of exposure, free from interferences such as buildings or other high objects or structures. Accessibility and security are other considerations in site selection.

The top of the container should be a minimum of 3 and a maximum of 15 meters above the ground and at least 1.5 meters above any other surface in the vicinity. Attachment to hydro poles is a common method of support.

During summer, an aqueous solution containing 1 mg/L of $CuSO_4$ may be added as an algal and fungal inhibitor provided that these substances will not affect the desired analysis. A dustfall collector containing two liters of the above solution tends to reduce loss of particulate matter by the action of wind currents. The use of "wet" collectors is not universal, and consultation with laboratory staff is recommended prior to their use.

It is important to establish the down-wind direction from the source being investigated and position the dustfall collector accordingly. After one exposure period the collector should be removed, capped and taken to the laboratory for analysis. Since the collector must be kept in an upright position, shipping by CN, CP, etc, is not feasible.

It is very important that a record of station number and installation and removal dates accompany the collector since this information is necessary to calculate the results.

3. HI-VOL FILTER SAMPLING

The collection of suspended particulate material involves filtration of air through a 20 cm x 25 cm (8" x 10") glass fibre filter using a vacuum pump capable of drawing at least 19 liters/min. The normal sampling period is 24 hours. A complete description of the Hi-Vol sampling device and procedure may be obtained from the ASTM publication, Gaseous Fuels; Coal and Coke; Atmospheric Analysis, Part 26, November 1978.

The sampler consists of a face plate, gasket and retaining ring, a filter adapter assembly, and a vacuum pump. The sampler is mounted vertically within a protective shelter. With the pump drawing 28 liter/min, the louvered shelter will only allow suspended particulates up to approximately 100 microns (aerodynamic diameter) to reach the filter. Pre-weighed and coded glass fibre filters and protective envelopes are available from the Air Quality Laboratory for use with these samplers. The filter must be carefully installed (rough side upwards) on the sampler, and the coded number recorded on the envelope. Ripped or punctured filters must be discarded. If difficulty is encountered due to wind, it may help to switch on the motor, thus holding down the filter while it is being secured by the frame. Preloaded cassettes have been found to be a useful method of replacing the glass fibre filter. The collection surface of the filter should not be touched at any time. Once the sampler has been prepared, the motor should be switched on and the air flow measured using the orifice manometer and the reading recorded on the envlope together with the preset time for start up.

The operator should then shut down the pump and reset the timer. The pump will then automatically start up and usually runs twenty-four hours (midnight to midnight). Once the sample has been collected, and before the filter is removed, the pump should be momentarily switched on and the final air-flow reading recorded as well as the day on which the filter was exposed. After carefully removing the filter, fold it in half along the 20 cm width, particulate side inwards and place in the corresponding envelope. Any comments peculiar to the sampling conditions should be noted. This is important for data evaluation.

The filter should be mailed to Air Resources Branch, 880 Bay Street, (4th Floor), Toronto, for calculation of the air volume. The filter is then forwarded to the Air Quality Section for analysis. Hi-Vol filters for the Northwestern Region are obtained from and sent to the Regional Laboratory in Thunder Bay.

Analysis of nonvolatile contaminants, such as benzo-a-pyrene (BaP), benzo-k-fluoranthene (BkF), polycyclic-aromatic - hydrocarbons (PAH), and benzene soluble organics, may be performed on subsamples from the Hi-Vol filters. Field sampling instructions in this regard are the same as above. These filters should be kept protected in envelopes and not be exposed to heat or sunlight.

Certain inorganic tests are incompatible with the glass fibre filters normally used. These include: Al, Ba, B, Ca, Na, K, Si and F. For these elements, polystyrene (Delbag) filters are recommended and are available from the Air Quality Section.

Note that total suspended particulates and organic contaminants cannot be determined on Delbag filters. In summary, the filter envelope must contain the following information:

i) Station number (i.e. sampling location)

ii) Hi-Vol instrument number, date and time of exposure

iii) Filter number

iv) Operator

v) Flow readings at start-up and shut-down

vi) Comments regarding incidents peculiar to the sampling period.

4. SAMPLING FOR ASBESTIFORM MINERAL FIBRES

The analytical technique of the determination for asbestiform fibres in air involves a time consuming electron microscopic examination of the processed samples. The expertise, time and instrumentation required for this analysis make it a very costly test. For these reasons, sampler discretion regarding submission of samples is requested. Every attempt should be made to preserve the integrity of the sample.

Asbestiform minerals in suspended air particulate are collected on a 0.4 µm pore size nuclepore filter using a modified Hi-Vol sampler. The modification consists of installing a flange with a 2 cm diameter opening on the air exit of the sampler. This opening acts as a limiting orifice and brings the air flow rate into a suitable measurement range. It is recommended that the Hi-Vol sampler be equipped with a transducer and an air flow rate recorder. The sampler must be recalibrated after the modifications have been performed. Procedures for calibration may be obtained from the laboratory or from the Technical Services Group, Central Region, 880 Bay Street, 1st Floor, Telephone: 965-2129.

It is very difficult to change the filter in the field and preinstallation of the filter in the Hi-Vol cassette inside an enclosed area is recommended. The entire cassette assembly is then attached to the air sampler. Removal of the filter should be performed in like manner.

After exposure, the filter is removed from the cassette, placed on the 20 x 25 cm separator sheet supplied with the filter and both then folded along the 20 cm width. The folded filter and separator are placed within a glassine envelope and mailed to the laboratory in the usual kraft paper Hi-Vol envelope, together with all pertinent sampling data. Samples requiring asbestos analysis should be mailed to the Physical Methods Section, Resources Road, Toronto.

5. SULPHATION AND FLUORIDATION RATES

Fluoridation rates are measured using the appropriate candles or plates, while sulphation rates are measured using the appropriate plate. These devices may be obtained from the Air Quality Section. The candle or plate should be removed from its protective cover and placed over the peg inside the candle cage or in the plate holder. After exposure for

approximately one month, the device should be replaced in its protective container and returned to the laboratory. A complete description of sampling considerations for sulphation rate can be found in the ASTM "Gaseous Fuels; Coal and Coke; Atmospheric Analysis", Part 26, November 1978.

Protective shelters are provided and installed by the regional staff. The stations should be located between 3 and 5 meters off the ground, and should be isolated from any obvious local interferences. Normal exposure time is thirty days. The exposed candle or plate should be carefully replaced in its protective cover, placed in its shipping container and sent to the Air Quality Section. Proper sealing of the candle or plate is important to prevent further atmospheric reaction occurring during transit. Regional staff should take care not to touch the reactive surface of the candle or plate at any time. The duration of exposure must be recorded and submitted with the candle or plate. Plates are recommended for any new surveys.

B - III. NON-ROUTINE TECHNIQUES

The following techniques may be used in special circumstances after discussion with laboratory staff. The sampling of volatile organic contaminants are covered by some of these techniques.

1. LOW VOLUME SAMPLING

"Low volume" techniques include sampling with impingers, adsorption tubes, and filters. Samples for the analysis of volatile organic components such as vinyl chloride, peroxy-acetyl-nitrate (PAN), volatile aliphatic, aromatic hydrocarbons and volatile organohalides may be collected by passing 100 to 1,000 mL of air per minute through a specially prepared tube containing activated charcoal, Chromosorb, or another suitable adsorbent. The normal sampling period is 2 - 4 hours. The tubes are available from the Organic Trace Contaminant Section. The sample, once collected, must be refrigerated and kept in the dark. The sample label attached to the tube must have the following information marked on it:

i) Date and location

ii) Pump time on and off

iii) Air flow rate at the start and finish

iv) Wind speed, direction, and temperature

Samples should be shipped (mailed) to the Organic Trace Contaminant Section, Resources Road, Toronto.

2. GRAB SAMPLES

An alternative way of sampling for volatile contaminants is by collecting a "grab" sample in Tedlar bags, aluminized Mylar bags, evacuated glass and metal containers, etc. A grab sample is taken by pumping air into the bag or filling an evacuated

container with air. This sampling method may be applicable in cases of odour problems, specifically volatile organic and inorganic sulphurous compounds such as H_2S and mercaptans.

An important consideration is that the contaminant does not react with or adsorb on the material of the container.

3. DETECTION TUBES

By observing the length of discolouration produced in a solid absorbent of a specific tube through which a known small volume of air is drawn, the approximate concentration of a pollutant can be estimated. This method is a rapid, semiquantitative procedure for measuring high levels of gaseous pollutants (SO_2, CO, H_2S) in the field.

4. CASCADE IMPACTORS

Impactor type samplers capable of separating particulate matter into size ranges according to their aerodynamic size are available. The cascade impactor separates particulate matter within the respirable range (.3 - 10 μm).

The sampler may be used for differentiating between sources of pollution. For example, lead emitted from automotive sources is found in the submicron fraction, while lead emitted from certain industrial operations as particles is deposited in the larger than one micron fractions.

The available impactors are used in association with Hi-Vol samplers. A problem specific to the cascade impactor is that the jets become clogged with dirt and require frequent cleaning to maintain its calibrated flow rate.

5. DICHOTOMOUS SAMPLER

Recently a new type of air fractionating instrument, called a dichotomous sampler has come on the market. It separates the dust into two size fractions, <2.5 microns and 2.5 - 15 microns. The samples are collected on inert filters, which are ideal for rapid chemical analysis using X-ray fluorescence.

6. STACK SAMPLING

Stack samples can be obtained by inserting probes into a vent through which gaseous or particulate emissions pass to the atmosphere. Emission rates can be calculated from analysis of samples. Rigid procedures must be followed in stack sampling to ensure representative samples are taken. Most of this sampling is carried out by experienced outside agencies. Analytical work on stack samples has been carried out in conjunction with investigations on special industrial source emissions.

B - IV. VEGETATION AND SOIL SAMPLING

1. GENERAL

The Phytotoxicology Section, Air Resources Branch (880 Bay Street), is responsible for the investigation of all complaints concerning suspected air pollution damage to vegetation or contamination of soil and the establishment of all vegetation and soil assessment surveys in the vicinity of proposed or exisiting industrial emission sources. The exception is in the Northeastern and Northwestern Regions, where the work is performed by the Technical Support Sections, with the assistance as required from Phytotoxicology personnel.

2. TYPE OF INVESTIGATIONS

a) ASSESSMENT SURVEYS

These surveys are conducted to document endemic conditions prior to the establishment of emission sources, to define the current state of air emissions from existing sources, and/or to monitor source compliance with Ministerial orders. Normally, a sampling grid is constructed, centred on the source and samples are taken from established stations, located at increasing distance along radii from the source to the limits of suspected contamination. Consideration is given to the location of air quality monitoring instruments and meteorological parameters such as prevailing wind direction.

b) COMPLAINT INVESTIGATIONS

Samples may also be taken to evaluate situations where extensive damage to vegetation has been observed. Cases of this nature will usually be drawn to the Ministry's attention through complaints by individual citizens. All complaints of this nature should be referred to the Phytotoxicology Section. They will be investigated and reported to the individual originating the complaint and to the source of the contaminant.

3. SAMPLING PROCEDURES

To ensure a correct interpretation of analytical data, all samples that are to be compared must be carefully matched with regard to plant species, age or maturity of leaf tissues, age of tree or shrub, and position of sample on tree or shrub. Usually, foliage is collected from the side of the tree or shrub facing the presumed source of air pollution but, occasionally, a second sample may be taken from the side opposite from the source. Samples are taken by trimming outside growth from ground level up to 6 meters or more and collecting all leaves to provide a composite sample of 500 to 1,000 grams of fresh material.

Current practice is to collect three samples from each sampling location (triplicate sampling). Samples are placed into perforated polyethylene bags and are transferred to refrigerated storage as soon as possible for processing in the Phytotoxicology laboratory. Forage samples (grass) are collected by cutting the terminal 25 cm (10") of stems and blades over the representative area to be sampled, at 10-step intervals. Dried flower heads and stalks are discarded and no root material whatsoever is included. The different forage species included in the sample are identified and are representative of the population of the species in the field.

Any sample contaminated by roadside dust should be noted in the accompanying request form.

Soil samples are normally collected in conjunction with vegetation samples as an aid to differentiate between current and past emission situations. Occasionally, soil samples will be collected to establish background conditions.

Soil is collected with a 2 cm (3/4") diameter stainless steel tube. A minimum of 10 cores is taken from the sampling site. Also, all soil samples are collected in triplicate (i.e. minimum 3 x 10 cores) and the collection form is completed to comprehensively describe the texture of the soil and the over-all sampling site. Each core must be separated into fractional depths of 0 - 5 cm, 5 - 10 cm and 10 - 15 cm, and each level is placed in an appropriately labelled plastic bag for shipping.

Ideally, soil should be sampled from an entirely undisturbed or sodded area and contaminated situations should be as closely matched as possible with conditions existing immediately outside of the area.

4. SAMPLE STABLIZATION

All vegetation samples as collected, are potentially unstable, and will decompose unless properly handled. Vegetation samples can be preserved for a few weeks under refrigeration. When dried at 80°C for 30 hours in a forced draft oven, they become almost permanently stable.

5. SAMPLE IDENTIFICATION

Collection of vegetation and soil samples is accompanied by the completion of a prenumbered PS2 Form (Phytotoxicology Field Sample Collection Form) which will later provide all the necessary information required for interpretation of the test results. The lower portion of the form is detachable and is placed in with the sample for identification. Normally samples are "double-bagged" with the numbered field sample enclosure slip placed between the outer and inner bags.

C. SAMPLE COLLECTION FOR THE ANALYSIS OF SEDIMENT, SOLID WASTES, SOIL AND BIOMATERIALS

C - I. COLLECTION OF SOIL, SEDIMENT, SOLID WASTES AND BIOMATERIAL SAMPLES FOR INORGANIC CONTAMINANTS ANALYSIS

1. GENERAL

The Soils and Sediment laboratory generally carries out sample digestion or leaching on solid samples for a number of tests performed by other sections as well as performing unique sediment analyses. These are given in Table III along with the required sample size and method of preparation.

2. SAMPLING CONSIDERATIONS

i) Where possible, composite sampling will result in a more representative sample than a single grab.

ii) All possible sources of sample contamination should be reduced to a minimal level.

iii) Chemical preservatives are generally not applicable to samples of this type.

iv) Preparation of these types of samples for chemical analysis generally takes longer than for water or effluent, and as a result, samples requiring immediate attention should be so marked after prior consultation with F. C. Darcel (248-3346).

The laboratory should also be notified well in advance of a forthcoming heavy sample and/or test input and indication given of the urgency and priority.

v) Samplers should be aware of pertinent information regarding submission procedures as outlined in Section A - VIII.

3. SAMPLE CONTAINERS

Any clean glass or plastic container is acceptable for sediment, soils or biomaterial samples. While not recommended, paper bags can be used for "dry" soil samples where contamination from the container is not anticipated to affect the analysis (e.g. particle size analysis). In general, wide mouth 60, 125, 250, 500 or 1000 mL glass or plastic containers are the most suitable, depending upon sample size. When a number of samples are submitted as a series, uniformity of sample container size is recommended for shipping, handling and storage convenience. Plastic bags (Twirl-top) are usually adequate for dried vegetation samples. Containers should be clearly labelled and samples numbered in sequence, preferably from No. 1. Indicate the number of containers for a sample when there is more than one.

4. PRESERVATION TECHNIQUES

Chemical preservation techniques are generally not applicable to solid type samples. In the short term, storage at 4°C or freezing will minimize the transformation of species, particularly if a soluble or "available" parameter is desired.

Drying as a preservation technique is recommended except for those samples requiring analysis of potentially volatile parameters. In practice, a portion of each sample received in the laboratory is oven dried at 110°C after which most chemical tests are performed. In general, dried samples are indefinitely stable.

Air or oven drying at 80°C of vegetation samples before submission to the laboratory is recommended and where this is not possible, the laboratory must be notified so that the samples can be dried without delay. This is particularly important since decaying plant material could significantly alter nutrient values.

5. SAMPLE SIZE

The field sampling personnel must be aware of the general non-homogeneity of solid samples and thus the minimum sample size should reflect this consideration. As a general rule, however, a sample which will yield 10 - 25 g of dry material will be sufficient for all the routine chemical analyses. Special analyses will require more sample depending upon the tests requested. Where it is not possible to obtain a sufficiently large sample, special arrangements can be made with the laboratory personnel to perform the analyses in a given sequence so that the more important tests will be completed first. If leachate potential tests are required on industrial waste materials, larger sample sizes will usually be required (500 g). Do not dry before shipment.

6. SAMPLING METHODOLOGY AND FIELD RECORDS

The sampling personnel are usually in control of the sampling methodology and must be aware of how the particular details of the procedures and sampling apparatus (e.g. coring vs dredge devices) may bias the results which are eventually obtained.

C - II. COLLECTION OF FISH SAMPLES FOR INORGANIC AND ORGANIC CONTAMINANTS ANALYSES

1. ANALYTICAL TESTING CAPABILITIES

Fish samples, normally muscle tissue, are frequently analyzed for mercury or other metals by the Air Quality Section; pesticides and PCB's by the Pesticide Section, and other organics by the Organic Trace Contaminants Section. The following sample procedures should be closely followed in order to obtain meaningful data as to the existence and degree of contamination.

2. SAMPLE PREPARATION AND SUBMISSION

i) Details of catch, total length (cm), weight (g), sex (if possible) must be neatly recorded on the submission sheet. For proper statistical evaluation there should be a minimum of 10 fish per species. As with all samples, the required analyses should also be indicated on the submission sheet.

ii) FILLETING

Samplers are requested to submit fillets (rather than the whole fish) for analysis. Normally the analysis is carried out on tissue from the epaxial muscle (Figure 2) by making an incision with a stainless steel knife on the dorsal surface of the fish as shown (Incision No. 1). The epaxial muscle is then removed by cutting from the initial incision toward the tail (Incision No. 2) until a sufficient quantity of tissue is obtained. The muscle may be finally separated from the body by (Incision No. 3). The skin should be removed from the sample.

It is important not to remove tissue from below the lateral line because of the high fat content in this region which makes PCB analysis impractical. The sample should be frozen immediately after filleting and transported to the laboratory in this condition. This is the only acceptable preservation technique. When a collection is ready for shipment to the laboratory, please phone prior to sending. For Hg or metals contact Darryl Russell at 248-3023. For PCB's or pesticides contact George Crawford at 248-3031.

iii) SAMPLE SIZE

The minimum and preferred quantities of tissue required for each type of analysis are as follows:

	Absolute minimum (g)	Preferred (g)
Mercury	20	50
Other Metals	50	100
PCB, Pesticides	10	50

iv) SAMPLE CONTAINERS

Individual samples collected for metals and mercury analysis may be placed in small plastic bags and then frozen. Clear identification with a sample code using a masking tape label is recommended, while the use of some variety of water-proof ink is a necessity.

Samples collected for PCB or pesticide analysis must be wrapped in solvent washed aluminum foil prior to freezing. Multiple washing of the foil and knife with hexane or acetone is a necessity. Samples submitted in plastic bags for these analyses will not be accepted. When both Hg and PCB's are required, submit the sample (frozen) in solvent washed foil.

3. OTHER CONSIDERATIONS

Analyses on tissues other than muscle is possible but can only be done by special arrangements. Any further queries should be directed to B. Loescher (248-3346), Air Quality Section, or G. Rees (248-3743), Pesticides Section.

D. LEGAL AND COMPLAINT SAMPLING

Sampling in connection with legal action naturally requires special care due to the influence this sampling may have on case outcome. Court cases are usually initiated to determine legal responsibility for reported pollution events (stream, well contamination, vegetation or paint damage, etc) and sampling must be conducted with this purpose in mind. In general, standard sampling methods as described previously may be used; however the following additional points and techniques should be fully read and understood before taking any legal samples.

D - 1. WATER SAMPLES FOR CHEMICAL AND MICROBIOLOGICAL ANALYSIS

The following points should be precisely adhered to when collecting court case water samples requiring chemical analyses:

i) The sampling area should be completely "walked", i.e. checked over at the time samples are taken. The sampler will then be completely familiar with the overall geographic "picture" (i.e. ALL possible contamination sources, unusual occurrences, and a "blank" sample location far enough away (upstream) that no contamination from the sources in question can influence it). Preparation of a sketch map of the area is recommended.

ii) The sampler should be careful to obtain samples at all possible contamination sources, not just the one in question. The observed contamination should be traced back to its source, and samples collected at key points to show continuity. In the case of an underground sewer, when the defendant or his official agent is unwilling to confirm continuity of flow of his wastes through the sewer, in front of a witness, the sampler should verify continuity by passing some small, identifiable floating object through the sewer, and recovering it at the outfall. Similarly a series of samples downstream is advised to show how the contamination effect persists. A prerequisite is a "blank" sample unaffected by the alleged pollution, (obtained upstream, or from a nearby well, etc).

iii) The sampler should obtain prior knowledge of exactly what type of contamination he is dealing with (i.e. what parameter(s) will be measured) and sample accordingly with respect to correct bottles, preservatives, etc.

iv) Legal samples must be analyzed in duplicate and thus it is recommended that at least three times the normal sample volume be submitted. Any remaining sample may then be used for further confirmation or presentation in court.

v) It is preferable but not essential that the actual sampling be performed with the assistance of a witness who is willing to sign a witness affidavit and appear in court if necessary.

vi) A complete record of exactly described sampling locations, time and date, bottle numbers, preservatives, etc, must be made. Submission sheets should accompany the samples in the normal manner. However, it is emphasized that the sample description and number on the bottle must exactly correspond to that on the sheet. If not, the certificate of analysis can be questioned, and may not be accepted as evidence.

vii) The sampler must be able to swear that the samples were in his possession and control before arrival at the laboratory, and not tampered with in any way. Samples and submission sheets should be placed in shipping boxes and padlocked and either delivered directly to the laboratory or sent by carrier. Boxes and padlocks can be obtained from Stores at the Central Laboratory (248-3051). If the box is delivered directly to the laboratory, contact N. Partridge in Stores (248-3051) and obtain a receipt for delivery, then contact the appropriate "analyst" to open the box and sign for the samples on the submission sheets. Delivery of samples should be made before 4:30 p.m. on weekdays. If this is not possible, leave the locked box (but not the key) with the security guard.

viii) It is the responsibility of the sampler to contact the appropriate analyst in order to forewarn him that a set of court case samples will be submitted. This is necessary so that the laboratory can make arrangements for the special handling procedures required in processing court case samples.

ix) Enquiries with regard to sampling and analysis should be directed to one or more of the following "analysts".

Water Quality Section	F. P. Dieken	248-3512
Air Quality Section (toxic metals in air, water, sediments, soils and industrial wastes)	F. C. Darcel	248-3346
Organic Section (oil and organic spills)	G. Whyhovsky	248-3031
Pesticides Section	J. Osborne	248-3031
Physical Testing (inorganic identifications, asbestos, etc.)	J. Pimenta	248-7101
Microbiology	J. A. Clark	248-3008
Regional Laboratories		
London Laboratory	D. Glutek	681-3600
Kingston Laboratory	S. MacBeth	549-4000
Thunder Bay Laboratory	A. Perras	475-1275

D - II. SAMPLING FOR PARTICLE IDENTIFICATION

In many instances, generally arising from citizens' complaints, it becomes necessary for field personnel to collect samples for constituent identification by means of microscopic, X-ray diffraction, electron probe and other techniques. The types of material normally encountered are visible solids present in air or water, that are a cause of nuisance or concern to the complainant. To facilitate the collection of these special samples, a sampling kit is available from the Laboratory Services Branch for each district office in the province. Supervisory personnel should obtain this and maintain this kit, which also includes more detailed sampling instructions. General guidelines to be used for sampling are given below.

1. AIR SAMPLES

Dust fallout is the most frequent cause of complaints. In these cases, the best method of obtaining a sample for particle identification is by brushing the dust into the specimen container (47 mm plastic petri dish) using a clean brush. THE PETRI DISH SHOULD NOT BE SEALED WITH ANY TYPE OF TAPE. The closed dish does not easily come apart. Dust, adhering strongly to any surface, may be removed by lifting it by means of scotch tape. While sampling with the tape, it is useful to the analyst if the damaged spots or particles are circled on the nonsticky side of the tape with a pencil or pen. Whenever tape has been used for sampling, it should be protected by means of the covering strip which comes with the tape or attached to a glass microscope slide. UNDER NO CONDITIONS SHOULD THE TAPE BE FOLDED ON ITSELF. When sampling suspected soot fallout (especially oil soot), the use of tape is not advisable, as the pressure used in collecting it, often destroys the identifying characteristics. In such cases it is better to remove a small paint section from outside window sills, shutters, etc. Plant leaves, eavestroughing, bird baths, furnace and air conditioner filters often act as collectors of particulate fallout. Where the fallout occurs consistently, aluminum weighing dishes, wetted with a glycerin-water mixture, can be used as miniature dustfall jars. These can be attached to a suitable vertical surface by means of a thumb tack. Samples can also be collected, using a household vacuum cleaner and a millipore field monitor, by means of a simple adapter placed between the monitor and the vacuum cleaner hose.

As a general rule, samples should not be collected from nonstationary objects such as automobiles, since the source of the dust may then be in question. Damage to automobile paint or house sidings is generally caused by very acidic or basic materials attacking the paint surface. Such types of fallout should be tested on the spot using pH indicator paper. It is often difficult to remove a representative sample from such surfaces, and on-site inspection by laboratory staff may be necessary to determine the cause of the damage.

Heavy dustfall onto snow should be sampled by scooping the snow into a large-mouth glass or plastic bottle in such a way as to maximize the amount of particulate material obtained and prevent any possible contamination from underlying soil.

All samples collected as a result of air pollution complaints should be accompanied by the analytical request and inspection report forms, which should provide all the information required to make a proper assessment of the situation.

A sketch map of the area is strongly recommended. Comparison samples of the suspected contaminants are always very useful in obtaining a positive identification of the fallout. Forward samples and forms to J. Pimenta, Physical Methods Section, Resources Road, (248-7101).

2. WATER SAMPLES

Water samples that require identification of the suspended solids, may be sent to the laboratory in any of the standard containers. A few milligrams of material are usually sufficient for microscopic analysis, although for complex mixtures requiring multi-instrumental analyses, up to a half gram of material would be preferable. Submit samples to J. Pimenta, Physical Methods Section (248-7101) if the material appears to be principally inorganic; if organic submit to G. Whyhovszky, Organic Trace Contaminants Section (248-3031).

D - III. SAMPLING FOR GAS DAMAGE COMPLAINTS

In cases of suspected gas damage, the stained surface such as paint work, should be accompanied with an unstained sample, if available. Information as to the manufacturer and type of paint should also be obtained. Tarnishing of silverware, electrical contacts are usual indications of the presence of sulphide gases in the air. Where any type of damage due to corrosion has occurred (aluminum sidings, automobiles, wire fences), it is best to have laboratory staff inspect the damage and collect the sample for analysis. Special portable static samplers or gas detectors are available from the laboratory for sampling a number of gases. Contact G. S. Rees, Physical Methods Laboratory (248-7101) for information. If vegetation appears to be damaged, consult the Phytotoxicology Section (965-4516).

TABLE I

ANALYTICAL TESTING CAPABILITIES - LABORATORY SERVICES BRANCH

Please consult Table II for Sampling Requirements

CODE - W - Water Quality Section
A - Air Quality Section
O - Organic Trace Contaminants Section
P - Pesticides Section
Φ - Physical Methods Section
L - London Regional Laboratory
T - Thunder Bay Regional Laboratory
K - Kingston Regional Laboratory

MAJOR IONS	W	A	O	P	Φ	L	T	K
Alkalinity	X					X	X	X
Calcium	X	X				X	X	X
Chloride	X	X			X	X	X	X
Conductivity	X					X	X	X
Hardness	X					X	X	X
Magnesium	X	X				X	X	X
Potassium	X	X				X	X	X
Silicates - Reactive	X					X	X	
Sodium	X	X				X	X	X
Sulphate	X	X				X	X	

NUTRIENTS	W	A	O	P	Φ	L	T	K
Ammonia Nitrogen (Filtered)	X	X				X	X	X
Nitrate Nitrogen (Filtered)	X	X				X	X	X
Nitrite Nitrogen (Filtered)	X					X	X	X
Nitrogen - Total Kjeldahl	X					X	X	X
Phosphorus - Total	X				X	X	X	X
Phosphorus - Filtered Reactive	X					X	X	X
Phosphorus - Filtered Total	X					X		
Phosphorus - P^{32}					X			

METALS	W	A	O	P	Φ	L	T	K
Aluminum		X					X	
Antimony - Total		X						
Arsenic		X					X	
Barium		X						
Beryllium		X						
Boron		X						
Cadmium		X					X	
Chromium - Hexavalent		X						
Chromium - Total		X					X	
Cobalt		X					X	
Copper		X					X	
Iron (Total)	X	X				X	X	X
Lead		X			X		X	
Lithium		X						
Manganese	X	X					X	
Mercury		X					X	
Molybdenum		X						
Nickel		X					X	
Selenium		X						
Silver		X						
Strontium		X						
Thallium		X						
Titanium		X						
Uranium		X						
Vanadium		X						
Zinc		X					X	

TABLE I (Cont'd) - ANALYTICAL TESTING CAPABILITIES

Please consult Table II for Sampling Requirements

ORGANIC	W	A	O	P	Φ	L	T	K
Alcohols			X					
Anionic Detergents - see MBAS	X					X		
Aromatic Hydrocarbons			X					
Benzene Soluble Organics			X					
Biochemical Oxygen Demand	X					X	X	X
Carbon - Free (Elemental)					X			
Carbon Dioxide	X							
Carbon - Dissolved Inorganic	X							
Carbon - Dissolved Organic	X							
Carbon - Inorganic	X				X	X		
Carbon - Total	X				X	X		
Carbon - C^{14}					X			
Chemical Oxygen Demand	X					X	X	X
Fatty Acids - Volatile			X					
- Citric Acid			X					
- Maleic Acid			X					
- Phthalic Acid			X					
Foams			X					
Freons			X					
Hexachlorobenzene				X				
Hydrocarbon Gases			X					
Mercaptans - see Volatile Sulfurous Organics			X					
Methane - see Hydrocarbon gases			X					
Methylene Blue Active Substances	X					X		
Petroleum Hydrocarbons (Gasoline)			X					
Phenolics - Reactive	X					X	X	
Polybrominated Biphenyls				X				
Polychlorinated Biphenyls				X				
Polynuclear Aromatic Hydrocarbons			X					
Resins and Fatty Acids			X					
Solvent Extractables			X					
Tannins and Lignins			X					
Tracer Dyes			X					
Vinyl Chloride			X					
Volatile Acids	X					X		
Volatile Organohalides			X					
Volatile Sulfurous Organics			X					

OTHER	W	A	O	P	Φ	L	T	K
Acidity	X					X	X	X
Asbestos					X			
Chlorine - Total Residual	X							
Chlorine - Free Available	X							
Chlorine - Monochloramine	X							
Chlorine - Dichloramine	X							
Chlorophyll	X						X	
Colour - Apparent	X					X	X	X
Colour Dilution		X						
Cyanide			X					
Dustfall		X				X	X	
Fluoridation Rate		X						
Fluoride	X	X				X	X	X
Loss on Ignition		X					X	X
Oxygen - Dissolved	X					X	X	X
Particle Size Analysis		X			X			
Particle Size by Microscopy					X			
Particulate Identification (Complaint)		X			X			
pH	X	X				X	X	X
Settleability	X							
Sieve Analysis					X			
Silicon		X						
Sludge Volume Index	X							
Solids - Filtered	X					X	X	X
Solids - Ignited	X					X	X	X
Solids - Suspended	X					X	X	X
Solids - Total	X					X	X	X
Sulfation Rate		X						
Sulfide	X	X				X		
Sulfite		X						
Sulfur - Total		X			X			
Sulfur - Trace by S^{35} dilution					X			
Suspended Air Particulates - Total		X					X	
Thiocyanate		X						
Turbidity	X					X	X	X

TABLE I (Cont'd) - ANALYTICAL TESTING CAPABILITIES

Please consult Table II & Table III for Sampling Requirements

PESTICIDES

All pesticide analyses are conducted at the Central Laboratory, Toronto.

Carbamate Insecticides/Herbicides
Chlorinated Aromatics
Chlorophenoxy Acid Herbicides
Organochlorine Pesticides
Organophosphorus Insecticides
Phenyl Urea Herbicides
Triazine Herbicides

SEDIMENTS AND SOILS	W	A	O	P	ϕ	L	T	K
Chemical								
Chemical Oxygen Demand		X						
Extractable Metals - DTPA		X						
Hot Acid Extraction		X						
Leachate		X						
Mild Extraction		X						
Sequential Extraction		X						
Total Metals		X						
Physical								
Cation Exchange Capacity		X						
Loss on Ignition		X						
Moisture Content		X						
Particle Size Distribution		X						
Permeability		X						
Plasticity		X						

MICROBIOLOGY	C	L	T	K
C = Central Laboratory, Toronto				
Fecal Pollution Indicators				
Coliforms - Total	X	X	X	X
Coliforms - Fecal	X	X	X	X
Escherichia coli	X	X	X	X
Fecal Streptococci	X	X	X	X
Presence Absence Procedure	X	X	X	X
Pseudomonas aeruginosa	X	X	X	X
Industrial/Agricultural Pollution Indicators				
Klebsiella	X	X	X	X
Nitrogen cycle bacteria				
- Denitrifying bacteria	X	X	X	X
- Nitrobacter	X	X	X	X
- Nitrosomonas	X	X	X	X
Phenol Degraders	X	X	X	X
Sulfur Oxidizers				
- Thiobacillus Ferrooxidans	X	X	X	X
- Thiobacillus Thiooxidans	X	X	X	X
- Thiobacillus Thioparus	X	X	X	X
Nuisance Organisms	X			
Organic Enrichment Indicators				
Fungi	X			
Heterotrophic bacteria				
- Surface Water	X	X	X	X
- Treated Water	X	X	X	X
Taxonomy	X	X	X	X

TABLE II - SPECIFIC PARAMETER INFORMATION

A number of the determinations listed in Table II may be applied to several sample matrices. The information in the table is for aqueous samples unless otherwise stated. Other eligible matrices are indicated by initial in parentheses in the comments column, and sampling information is available from the appropriate laboratory section. Ambient air samples are collected in aluminized plastic bags, 5 to 22 L.
H = Hi-Vol filters; V = Vegetation; S = Sediments & Soils; A = Ambient Air; B = Biomaterials, Fish; D = Dustfall

Parameter	Container	Preservation Technique	Minimum Volume Required	Comment or Common Name
MAJOR IONS				
Alkalinity	Glass or Plastic		75 mL	
Calcium	" "		75 mL	
Chloride	" "		50 mL	
Conductivity	" "		75 mL	Specific Conductance
Hardness	" "	None	75 mL	
Magnesium	" "		75 mL	
Potassium	" "		40 mL	
Silicates - Reactive	Plastic only		50 mL	Silica
Sodium	Glass or Plastic		40 mL	
Sulphate	" "		50 mL	
NUTRIENTS				
Ammonia Nitrogen (Filtered)				Free Ammonia
Nitrate Nitrogen (Filtered)				
Nitrite Nitrogen (Filtered	Glass or Plastic (polystyrene not linear polyethylene)	Freeze or Refrigerate	75 mL	
Nitrogen - Total Kjeldahl				
Phosphorus - Total				
Phosphorus - Filtered Reactive				Soluble Phosphorus, Orthophosphate
Phosphorus - Filtered Total	Screw-cap culture	Filter in field	35 mL	Container available from Water Quality Section
Phosphorus - P^{32}	Consult with staff of the Physical Methods Section during the sampling or research program design phase.			

TABLE II - SPECIFIC PARAMETER INFORMATION (Cont'd)				
Parameter	Container	Preservation Technique	Minimum Volume Required	Comment or Common Name
METALS				
Aluminum Barium Beryllium Cadmium Chromium Cobalt Copper Iron Lead Lithium Manganese Molybdenum Nickel Silver Strontium Thallium Titanium Uranium Vanadium Zinc	Plastic or Glass[2]	HNO_3 to pH of 2 (approximately 20 drops per bottle)[1]	100 mL; 900 mL required for preconcentration (ultra-trace analysis)	([4]H, V, S, D, B)
Antimony - Total	Plastic or Glass[2]	None	100 mL	(H, V, S, D, B)
Arsenic	" "	None	50 mL	(V, S, D, B)
Boron	Plastic only	None	100 mL	(V, S, D, B)
Chromium - hexavalent	Glass only	None	100 mL	(V, S, D)
Mercury	Glass only	$HNO_3 + KMnO_4$[3]	176[3] mL	(V, S, B)
Selenium	Plastic or Glass[2]	None	100 mL	(H, V, S, D, B)

[1]Nitric acid preservative should be added AFTER the sample is placed in the bottle. If the samples contains visible suspended solids or where a hazardous chemical reaction between the sample and the acid may occur, submit the sample unpreserved.

[2]Acid washed plastic containers are required for ultra-trace analysis; glass bottles must have non-metallic cap liners.

[3]A special 176 mL sample bottle similar to the microbial analysis type is usually provided for Hg samples. Add HNO_3 to pH 2 and sufficient $KMnO_4$ to maintain a slight pink colour. Omit preservation where dangerous reactions may occur, or where the sample is heavily contaminated with organic material.

[4]Most of the metals listed can be determined on Hi-Vol filters, vegetation, sediment/soils, and dustfall, some of the metals listed can be determined on biomaterials. For specific metals, contact appropriate A.Q.S. staff (Appendix I).

TABLE II - SPECIFIC PARAMETER INFORMATION (Cont'd)				
Parameter	Container	Preservation Technique	Minimum Volume Required	Comment or Common Name
ORGANIC				
Alcohols	Glass	Refrigerate	1 liter	
Anionic Detergents - see MBAS, below				
Aromatic Hydrocarbons	Glass	Refrigerate	1 liter	
Benzene Soluble Organics				(D, H, S, B, A)
Biochemical Oxygen Demand	Glass	Refrigerate	500 mL	BOD_5
Carbon - Free (Elemental)				(H, S)
Carbon Dioxide	Special (1)	Refrigerate	-	Free CO_2
Carbon - Dissolved Inorganic	Glass or Plastic	"	50 mL	
Carbon - Dissolved Organic	Glass or Plastic	"	"	
Carbon - Inorganic	Glass or Plastic	"	"	(H, S)
Carbon - Total	Glass or Plastic	"	"	(H, S)
Carbon - C^{14}	- Consult with Physical Methods Section			
Chemical Oxygen Demand	Glass	Refrigerate	25 mL	C.O.D.
Fatty Acids - Volatile	Glass	Adjust to pH 3 with HCl; refrigerate	1 liter	
- Citric Acid				
- Maleic Acid	- Consult with Organic Trace Contaminants Section			
- Phthalic Acid				
Foams	Glass	Refrigerate	Consult with OTC Section	
Freons	Glass	Consult with OTC Section		(A)
Hexachlorobenzene	Glass (2)	Refrigerate	(2)	HCB
Hydrocarbon Gases	Glass	Refrigerate	1 liter	(A)

TABLE II - SPECIFIC PARAMETER INFORMATION (Cont'd)

Parameter	Container	Preservation Technique	Minimum Volume Required	Comment or Common Name
ORGANIC Cont'd				
Mercaptans - see Volatile Sulfurous Organics				
Methane - see Hydrocarbon gases				
Methylene Blue Active Substances	Glass	Refrigerate	100 mL	MBAS, ABS, LAS, Detergents
Petroleum Hydrocarbons(Gasoline)	Glass	"	1 liter	
Phenolics - Reactive	Glass	$CuSO_4$ - H_3PO_4	176 mL	A special bottle containing preservative is available.
Polybrominated Biphenyls	Glass (2)	Refrigerate	(2)	PBB
Polychlorinated Biphenyls	Glass (2)	Refrigerate	(2)	PCB
Polynuclear Aromatic Hydrocarbons	Glass	"	1 liter	PAH
Resins and Fatty Acids	Glass	Adjust to pH 3 with HCl; refrigerate	1 liter	
Solvent Extractables	Glass	Refrigerate	1 liter	Ether Solubles
Tannins and Lignins	Glass	"	200 mL	
Tracer Dyes	Consult with Organic Trace Contaminants Section			
Vinyl Chloride	Glass	Refrigerate	1 liter	(A)
Volatile Acids	Glass	"	25 mL	(Combined, for sewage sludges)
Volatile Organohalides	Glass	"	1 liter	
Volatile Sulfurous Organics	Glass	"	1 liter	(A)

1. CO_2 samples are to be carefully transferred from the sampling device into the bottom of a leak-proof glass stoppered container so as to prevent splashing (syphon); after copious overflow the bottle must be stoppered excluding air and rushed to a laboratory.
2. Special solvent washed containers are supplied. Fill container to mark, approx. 900 mL.
3. Special "hypovial" container and septum, and loan of a crimping tool available from the O.T.C. Section, Toronto.

TABLE II - SPECIFIC PARAMETER INFORMATION (Cont'd)

Parameter	Container	Preservation Technique	Minimum Volume Required	Comment or Common Name
OTHER				
Acidity	Glass or Plastic	Refrigerated	50 mL	
Asbestos	Plastic	Refrigerate Elapsed time between sampling and analysis must be less than 48 hours.	1 liter	(H, special filter)
Chlorine - Total Residual	Glass	(1)	500 mL	
Chlorine - Free Available	"	(1)	500 mL	
Chlorine - Monochloramine	"	(1)	500 mL	(H, V; disregard note (1))
Chlorine - Dichloramine	"	(1)	500 mL	
Chlorophyll	Field filtration preferred	5 drops 10% $MgCO_3$ per liter prior to filtration	500 mL	Contact Water Quality Section for information.
Colour - Apparent	Glass or Plastic	Refrigerate	75 mL	Hazen Colour Units
Colour Dilution	Glass or Plastic	Refrigerate	50 mL	
Cyanide	Glass or Plastic	NaOH to pH $\geq$ 11	500 mL	
Dustfall	See text, page 13			
Fluoridation Rate	See text, Page 15			
Fluoride	Glass or Plastic	Refrigerate	50 mL	(H, V, B by ISE (3))
Loss on Ignition	Glass or Plastic	Refrigerate	500 mL	(D, H, S, V); see also Solids - Ignited
Oxygen - Dissolved	Glass	(1)	1 liter	
Particles Size Analysis	Sediment samples only			
Particles Size by Microscopy	Non-aqueous samples only			
Particulate Identification (Complaint Samples)	For Air Quality Section parameters, contact the section. For Physical Methods Section, submit samples in any suitable container.			

TABLE II - SPECIFIC PARAMETER INFORMATION (Cont'd)

Parameter	Container	Preservation Technique	Minimum Volume Required	Comment or Common Name
OTHER Cont'd				
pH	Glass or Plastic	Refrigerate	50 mL	
Settleability	Glass	"	900 mL	
Sieve Analysis	Non-aqueous samples only			
Silicon	Non-Aqueous samples only			
Sludge Volume Index	-	-	-	Calculated parameter
Solids - Filtered	Glass	Refrigerate	75 mL	
Solids - Ignited	"	"	1 liter	
Solids - Suspended	Glass	Refrigerate	600 mL	
Solids - Total	Glass	"	75 mL	
Sulfation Rate	See text - Page 15			
Sulfide	Glass or Plastic	Zn acetate + Na_2CO_3 (2)	900 mL	Consult Air Quality Section prior to sampling
Sulfite	Glass or Plastic	Refrigerate	1 liter	
Sulfur - Total	Non-aqueous samples only			
Sulfur - Trace by S^{35} dilution	Consult with Physical Methods Section			
Suspended Air Particulates - Total	Hi-Vol filters only			TSP
Thiocyanate	Glass or Plastic	NaOH to pH $\geq$ 11	1 liter	
Turbidity	Glass or Plastic	Keep in darkness	50 mL	

(1) Due to the perishable nature of the measured constituents, analysis should ideally be performed on-site. For lab analysis, after proper sampling and refrigeration, samples must be submitted within 4 hours of collection with prior laboratory notification.

(2) 2 mL of 2N Zinc Acetate followed by dropwise addition of 5% Sodium Carbonate solution until precipitation complete.

(3) ISE = Ion Selective Electrode

TABLE II - SPECIFIC PARAMETER INFORMATION (Cont'd)

Parameter	Container	Preservation Technique	Minimum Volume Required	Comment
PESTICIDES				
Carbamate Insecticides/Herbicides		Refrigerate	Fill container to mark, approx. 900 mL	Scan
Chlorinated Aromatics (1)	A special solvent rinsed container is required and is available through Central Stores.			Scan
Chlorophenoxy Acid Herbicides		"	"	Scan
Organochlorine Pesticides		"	"	Scan
Organophosphorus Insecticides		"	"	Scan
Phenyl Urea Herbicides (1)				Scan
Triazine Herbicides		"	"	Scan

1. Available on a low volume, by special arrangement basis only.

The Pesticides section will, by special arrangement, undertake a low volume of custom miscellaneous pesticide analyses where the above listed classes are inappropriate to the data user's needs. The section is also developing methods to cover a wide range of industrially produced organic contaminants, and invites inquiries from interested samplers.

TABLE II - SPECIFIC PARAMETER INFORMATION (Cont'd)				
Parameter	Preferred Sampling Container	Preservation Technique	Minimum Volume of Sample (mL)	Analytical Technique
MICROBIOLOGY				
Fecal Pollution Indicators				
Routine				
Coliforms - Total	Presterilized Glass Bottles	Refrigeration; Thiosulphate as required for chlorinated samples (see text)	150	Membrane Filtration Incubation on Selective Agar
- Fecal	"	"	"	"
Fecal Streptococci	"	"	"	"
Presence Absence Procedure	"	"	"	"
Pseudomonas aeruginosa	"	"	"	"
Non-routine				
*Escherichia coli	"	"	"	"
*Salmonella	"	"	500 - 1000	Membrane Filtration or Moore Swabs - Incubation In Selective Broth
Organic Enrichment Indicators				
*Fungi	"	"	150	Membrane Filtration Incubation on Selective Agar
Heterotrophic Bacteria				
- Surface Water	"	"	"	Spot or Spread Plate
- Treated Water	"	"	"	Incubation on Non-Selective Agar
Nuisance Organisms	"	"	"	Direct Microscopy or MPN Incubation in Selective Broth
Taxonomy	"	"	"	Direct Microscopy and Biochemical Testing

TABLE II - SPECIFIC PARAMETER INFORMATION (Cont'd)

Parameter	Preferred Sampling Container	Preservation Technique	Minimum Volume of Sample (mL)	Analytical Technique
MICROBIOLOGY Cont'd				
Specific (Industrial/Agricultural) Pollution Indicators				
*Klebsiella	Presterilized Glass Bottles	Refrigeration: Thiosulphate as required for chlorinated samples (see text)	150	Membrane Filtration Incubation on Selective Agar
Phenol degraders	"	"	"	MPN Incubation in Selective Broth
Nitrogen Cycle Bacteria				
- Nitrosomonas	"	"	"	"
- Nitrobacter	"	"	"	"
- Denitrifying Bacteria	"	"	"	"
Sulphate Reducers	"	Refrigeration only	"	"
Sulphur Oxidizers				
- Thiobacillus Ferrooxidans	"	"	"	"
- Thiobacillus Thioparus	"	"	"	"
- Thiobacillus Thiooxidans	"	"	"	"

Specialized Capabilities

Techniques for collection, handling and analysis of samples will be determined by project needs and must be decided by consultation with the Microbiology Section. Methods are available to determine microbial biomass, metabolic activity and transformation reactions. Ames technique and virological analytical capabilities are being developed.

* Only by prior arrangement with the appropriate laboratory.

TABLE III

TESTS PERFORMED BY THE SEDIMENT & SOILS LABORATORY

Type of Test	Sample Size - Grams		Extracting Reagent	Parameters	Notes
	Minimum	Optimum			
CHEMICAL					
Hot Acid Extraction (Routine)	0.2	2+	HCl/HNO_3	Most metals	Analysis by AAS and ICAP
			H_2SO_4/HNO_3	Silver, titanium	
			$HClO_4/HNO_3$	Most metals	Vegetation
			H_2SO_4/persulphate	Total nitrogen & phosphorus	
			HCl (after ashing)	Potassium, sodium	
Total Metals (Non-Routine)	1	5+	$HNO_3/HClO_4/HF/H_2O_2$	Most metals (except silica)	Also analysis by powder spectrograph, including silica
Chemical Oxygen Demand	0.2	1	$H_2SO_4/K_2Cr_2O_7$		
Extractable Metals	5		DTPA	Some toxic metals (except lead)	Tentative
Mild Extraction Conditions (Non-routine)			Ammonium acetate	Some toxic metals	
			Acetic acid	Some toxic metals	
			Sulphuric acid	Metals, phosphorus	
			Hydrochloric acid	Metals	Sediments
			Water - cold	Anions, Metals & nutrients	
				Conductivity, pH	
			Water - hot	Boron	
			Copper chloride	Aluminum	Tentative
			Calcium chloride	pH	Preferred method
			Sodium bicarbonate	Phosphorus	Measure of "available" P
Sequential Extraction (Non-routine)	5	20+	Citrate-dithionite-bicarbonate	Apatite and non-apatite phosphorus	Measure of "available" P
			NaOH		
			HCl		
Leachate (Non-routine)	10	100+	Water	All	Column and "shake" leach tests
			Dilute acid	All	Usually "shake" tests
			Organic	All	Usually "shake" tests

TABLE III (Cont'd)

TESTS PERFORMED BY THE SEDIMENT & SOILS LABORATORY

Type of Test	Sample Size - Grams Minimum	Optimum	Extracting Reagent	Parameters	Notes
PHYSICAL					
Partical Size Distribution	5	10			
Plasticity	50				
Permeability	200				
Loss on Ignition	2	5			
Moisture Content	5	10			
Cation Exchange Capacity	10	50			

Note: For Non-routine tests it is usually advisable to consult with Sediment & Soil Laboratory staff (248-3346).

TABLE IV

SAMPLING SUPPLIES - CENTRAL STORES

CHEMICAL SAMPLING CONTAINERS

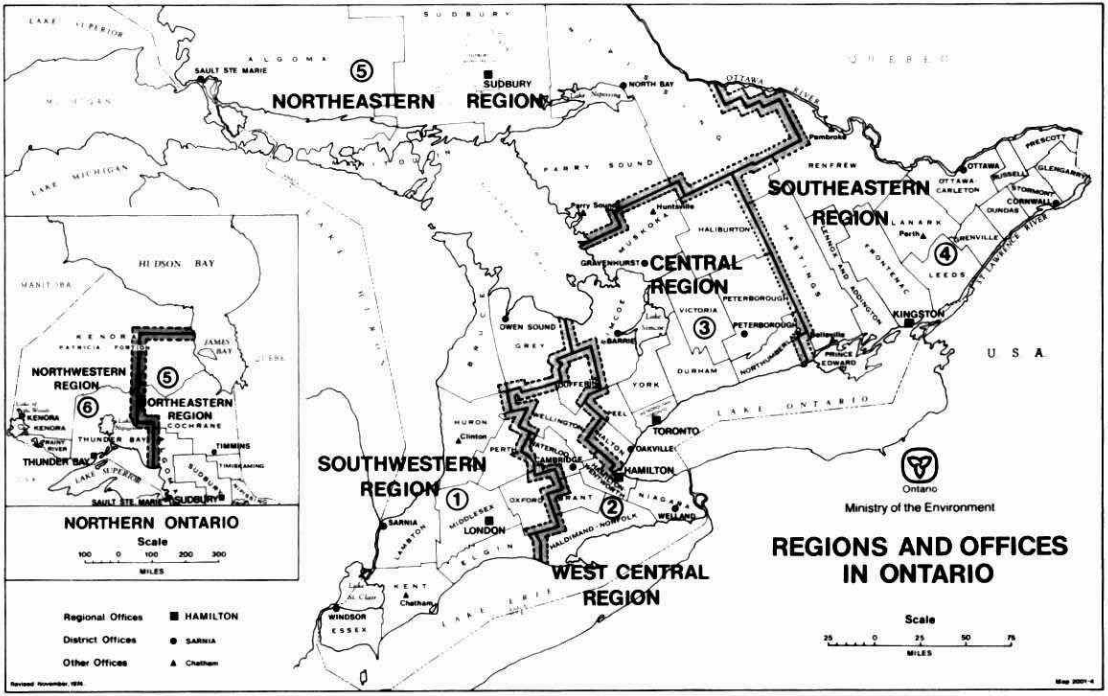
WM = Wide Mouth

Type of sample or analysis	Container	Pack contents	Pack No.	Special Features
Water, liquid wastes - general purpose - asbestos only	one liter Glass one liter WM Polyethylene	6 bottles (3 x 2) 1 bottle 4 bottles	Pack #3 Pack #1 Pack #16	express shipment cradled in solid styrofoam nest
Water; Public Health domestic inspections	200 mL Plastic	10 bottles in sleeves	Health Pack	Includes sleeves, mailing labels, submission form
Sludges, sediments - general purpose including metals	one liter WM Glass 500 mL WM Glass	6 jars (3 x 2) 12 jars (3 x 4)	Pack #4 Pack #5	pulp liner in cap standard - rubber or foil available on request
Metal analysis - general	one liter Glass one liter WM Polyethylene 500 mL WM Polyethylene	6 bottles (3 x 2) 6 jars (3 x 2) 6 jars (3 x 2)	Pack #3s Pack #9 Pack #11	pulp liner in cap standard - tin foil is unsuitable
Trace metals analysis	one liter WM Polyethylene 500 mL WM Polythylene	6 jars (3 x 2) Red Ring 6 jars (3 x 2) Red Ring	Pack #10 Pack #11A	container is acid washed - Red Ring
PCB or pesticides	one liter Glass 500 mL WM Glass	6 bottles (3 x 2) 12 jars (3 x 4)	Pack #3P Pack #5P	foil liner, container washed with solvents
Phenols	180 mL Glass Green Label	2 bottles 4 bottles	Pack #6P Pack #7P	white rubber liner, preservative added
Precipitation and low level nutrients	500 mL WM Polystyrene	9 jars (3 x3)	Pack #13	used once only
Low level nutrients	180 mL WM Polystyrene	12 jars (3 x 4)	Pack #12	freezable

MICROBIOLOGICAL SAMPLING CONTAINERS

Unchlorinated water -river, lakes, wells	180 mL Glass Blue Label	2 bottles 4 bottles 72 bottles (18 x 4)	Pack #6B Pack #7B Pack #8B	Pre-sterilized - Blue label
Chlorinated waters	180 mL Glass Red Label	2 bottles 4 bottles 72 bottles (18 x 4)	Pack #6T Pack #7T Pack #8T	Pre-sterilized, thiosulphate added - Red Label
Ice Pack	180 mL Glass	4 bottles	Pack #15	Container for ice

FIGURE I


NORTHEASTERN REGION
SUDBURY
SAULT STE MARIE
NORTH BAY
ALGOMA
SOUTHEASTERN REGION
OTTAWA
KINGSTON
CENTRAL REGION
PETERBOROUGH
GRAVENHURST
OWEN SOUND
BARRIE
TORONTO
OAKVILLE
HAMILTON
SOUTHWESTERN REGION
LONDON
SARNIA
WEST CENTRAL REGION
WINDSOR
ESSEX
Chatham
KENT
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE MICHIGAN
LAKE SUPERIOR
GEORGIAN BAY
OTTAWA RIVER
ST LAWRENCE RIVER
HUDSON BAY
MANITOBA
NORTHWESTERN REGION
NORTHEASTERN REGION
COCHRANE
THUNDER BAY
TIMMINS
KENORA
NORTHERN ONTARIO
Scale
100 0 100 200 300
MILES
Regional Offices HAMILTON
District Offices SARNIA
Other Offices Chatham
USA
Ontario
Ministry of the Environment
REGIONS AND OFFICES IN ONTARIO
Scale
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MILES

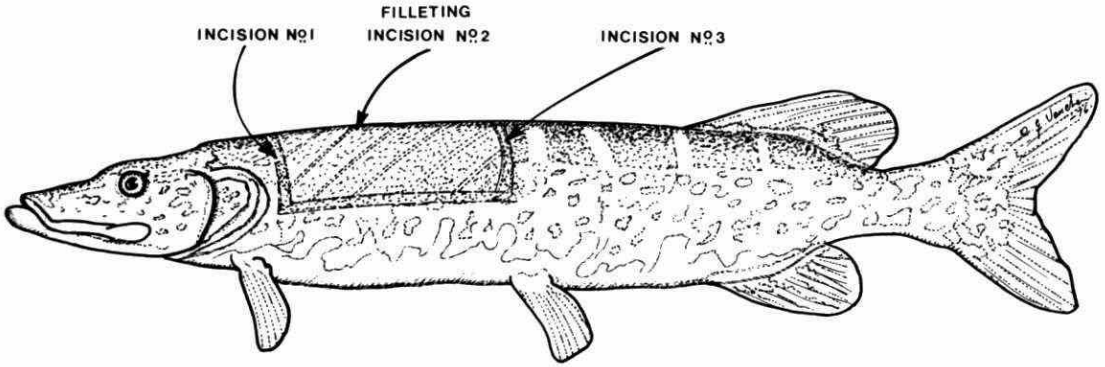

Figure 2

APPENDIX I

Enquiries regarding sampling and test procedures and the status of outstanding samples should be directed to the appropriate individuals listed below.

WATER QUALITY SECTION		
Sewage and Sludge Sampling and Analysis	Joan Crowther	
Well and Drinking Water Sampling and Analysis	Stuart Barnes	
River and Lake Sampling and Analysis	Mike Rawlings	416-248-3512
Precipitation, Snow and Low Level Nutrients	Frank Tomassini	
Legal Samples	Rusty Moody	
Electron Microscopy, Radiochemistry	Paul Roberts	
INORGANIC TRACE CONTAMINANTS SECTION		
Mercury Samples	Darryl Russell	416-248-3023
Metals, Fish, Legal Samples (Water)	Bernie Neary	248-3775
Sediments, Leach Tests	Frank Darcel	248-3346
Spectrographic Scans, Emission Spectrometer	Dave Boomer	248-3029
Hi-Vol, Dustfall,	Brian Foster	248-3346
Vegetation and Soils (Air Fallout)	Bob Harris	248-3346
Precipitation Samples	Barry Loescher	248-3346
Status of Samples through Lab	Cliff Lee	248-3775
Legal Samples	Jim Pimenta	248-7101
Particulate Identification	George Rees	248-3775
ORGANIC TRACE CONTAMINANTS SECTION		
Oil and Petroleum Hydrocarbons, Organic Characterization Court Cases	George Wyhovszky	416-248-3469
Haloforms in Water, PAH Air Sampling	Ed Adamek	248-3204
Priority Pollutants, Mass Spectrometry	Glenys Foster	248-3755

PESTICIDES SECTION		
Organochlorines	George Crawford	
Carbamates, Phenyl Urea	Pat Baulu	416-248-3743
Triazines, Organophosphates, Chlorophenoxy Acids, PCB, PBB, HCB, Chlorinated Aromatics	Joe Osborne	
MICROBIOLOGY SECTION		
Drinking Water	Jim Clark/Larry Sabatinos	
Lakes	Susan Janhurst	
Nuisance Organisms, Taxonomy	Michael Young	
Rivers and Wastes	G. Tanai	416-248-3008
Virology	Goff Jenkins	
Biohazardous Substances	David Rokosh	
LONDON REGIONAL LABORATORY		
Chief Laboratory Services	Dave Glutek	
Chemistry	Walter Cook	519-681-3600
Microbiology	Gary Palmateer	
THUNDER BAY REGIONAL LABORATORY		
Chief Laboratory Services	Al Perras	
Chemistry	Patrick Leung	807-475-1275
Microbiology	Stuart Irwin	
KINGSTON REGIONAL LABORATORY		
Chief Laboratory Services	Stan MacBeth	
Microbiology	Art Ley	613-549-4000
Chemistry	Dave Ferguson	
QUALITY CONTROL	Don King	416-248-3015
SHIPPING AND RECEIVING		
Sample Bottle Supply	Maurice Clearhill	416-248-3051

APPENDIX II

The following addresses should be used when shipping samples to the various laboratories:

a) CENTRAL REGION - MAIN TORONTO LABORATORY

Ontario Ministry of the Environment,
Central Stores,
Resources Road,
Highway 401 and Islington Ave.,
Toronto, Ontario.

b) SOUTHWESTERN REGION - LONDON LABORATORY

Ontario Ministry of the Environment,
Southwestern Regional Laboratory,
985 Adelaide Street South,
London, Ontario.

c) NORTHWESTERN REGION - THUNDER BAY LABORATORY

Ontario Ministry of the Environment,
Thunder Bay Regional Laboratory,
421 James Street South,
Thunder Bay, Ontario.

d) SOUTHEASTERN REGION - KINGSTON LABORATORY

Ontario Ministry of the Environment,
Southeastern Regional Laboratory,
133 Dalton Street,
Kingston, Ontario.

Further enquiries regarding container requisitions, shipping, etc, should be directed to Central Stores in Toronto (Telephone 248-7134).